Putting Volunteer Monitors in the Driver's Seat: Developing a Cyanobacteria Research Plan Around Their Needs

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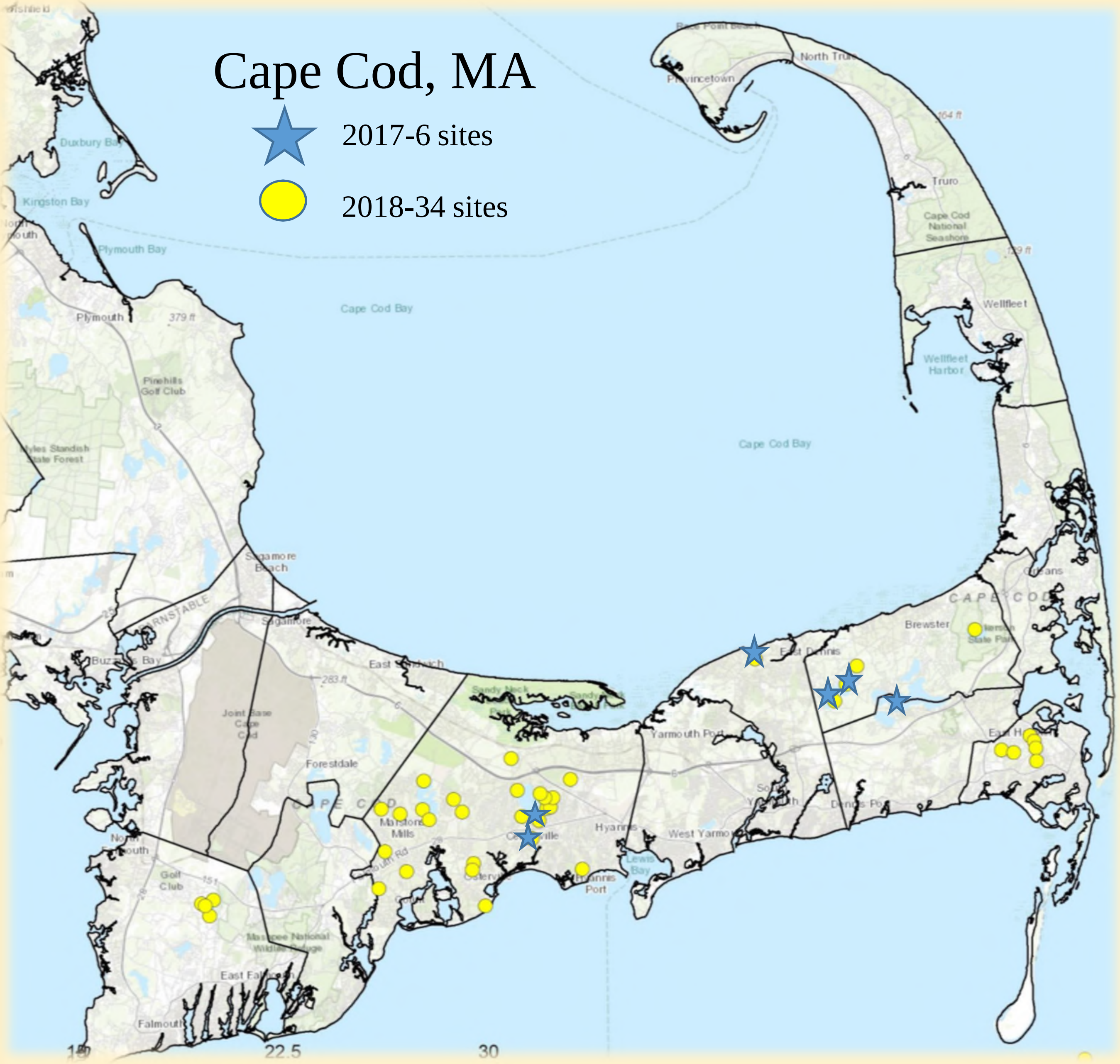


Proverbial Jim Haney quotes

"All monitoring is local"

"Keep it simple, we have an army to train"

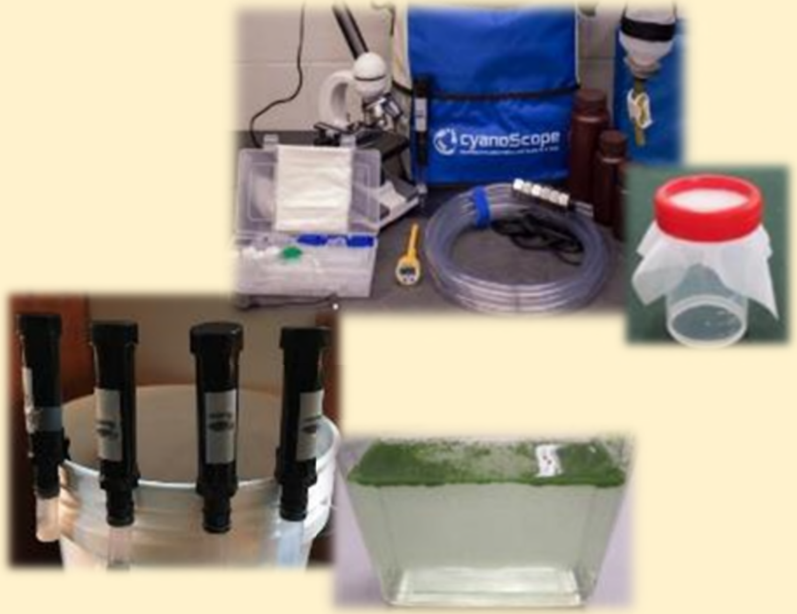
"It's their data, show them how to use it"

Citizen Scientists

Advocates, local staff, esearchers

Equipment

<50 µm, WLW, BFC isolates



Methods

Fluorometry:
Single Freeze-Thaw (SFT)

ELISA analysis:
Speed-vac (2-20X)

Our working hypotheses:

1) Population (size) structure integrates processes and constraints

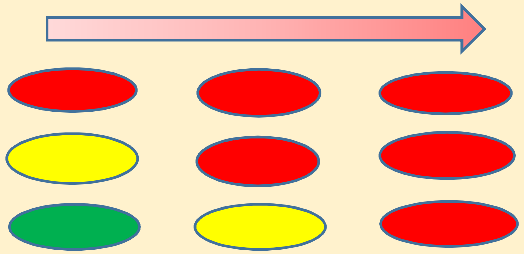
2) Temporal changes can determine and predict success

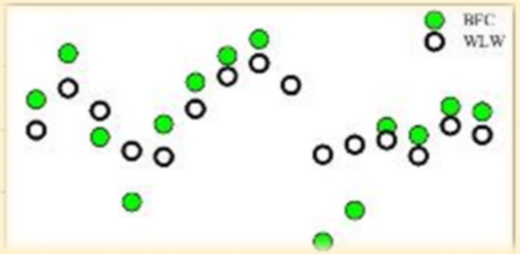
3) Changes in size structure mediates bloom initiation and risk associated with toxins

Composition

Dominance

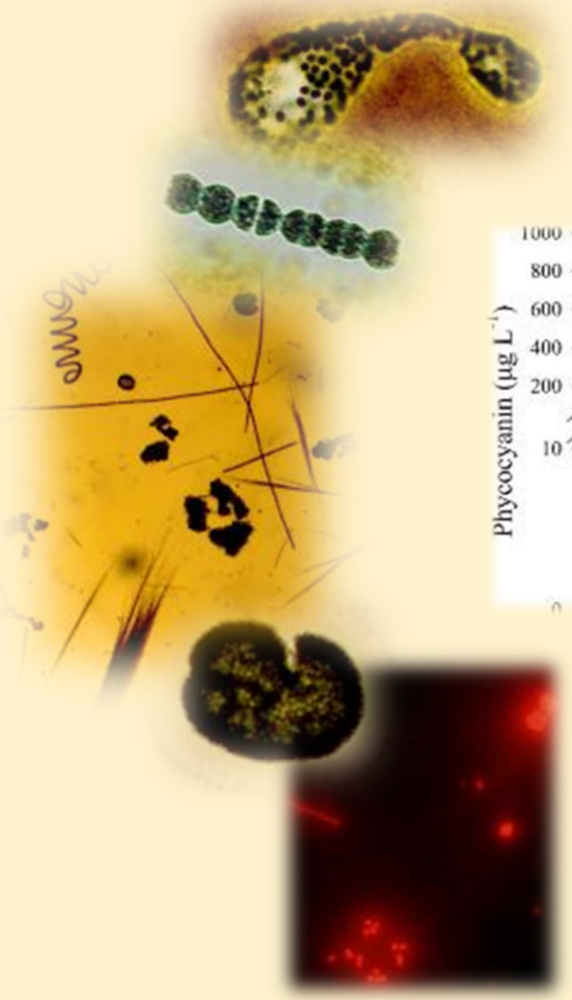
Growth

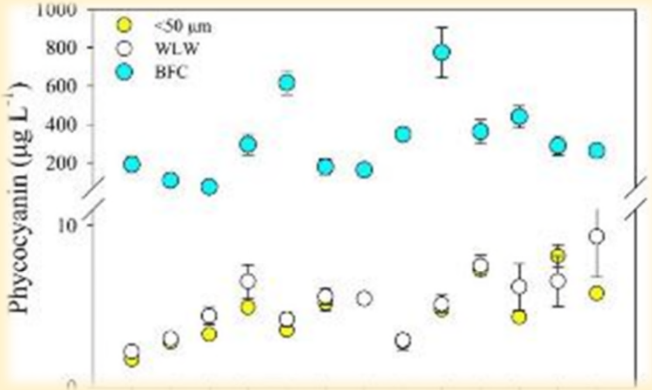


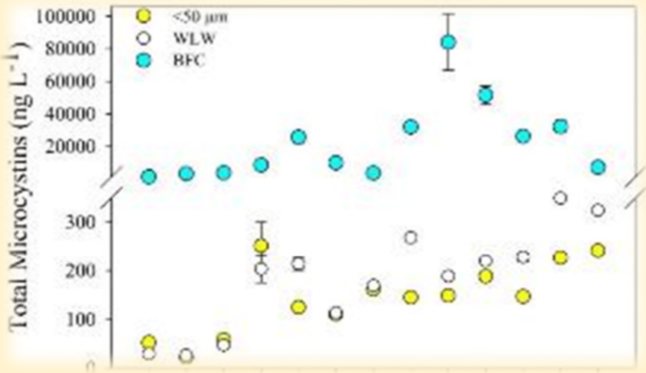


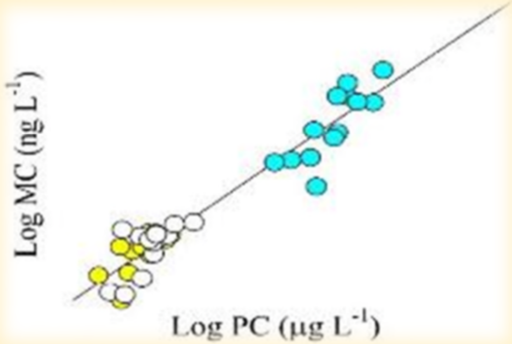
<u>This is where we started</u>

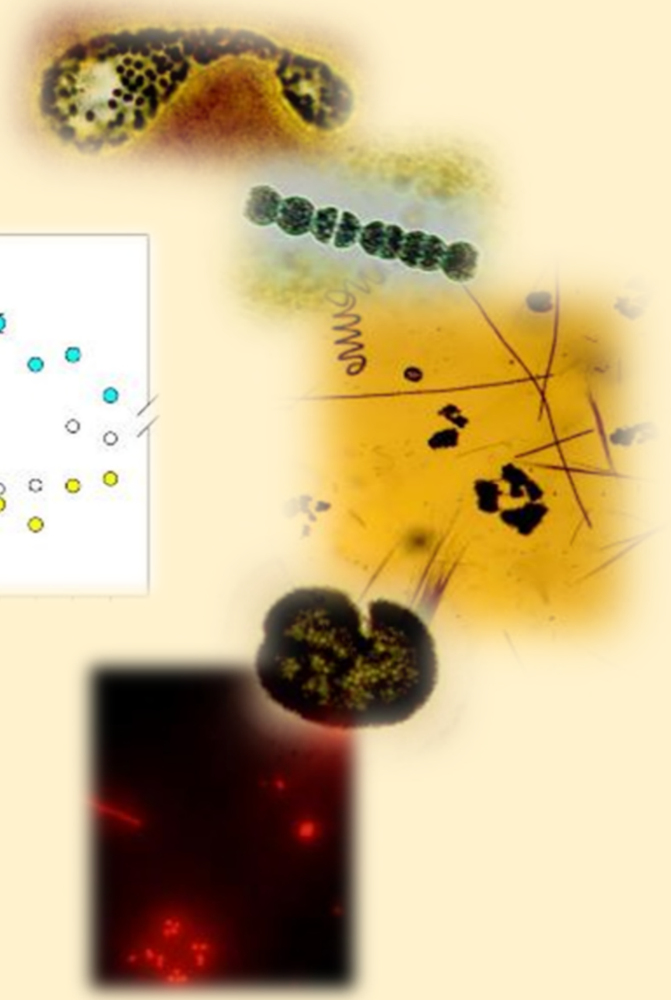
Composition



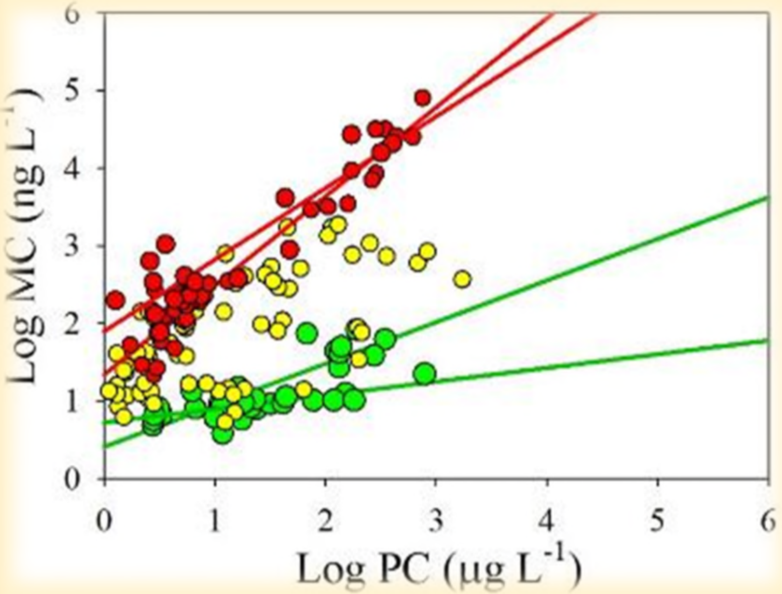








This is where we are
Composition and Dominance



The BFC Data Sheet

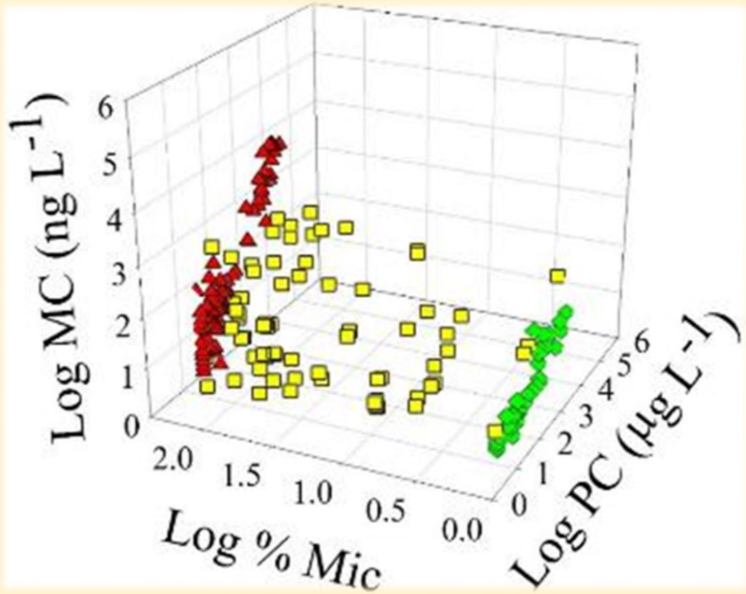
Semi-Quantitative Analysis for Bloom Forming Cyanobacteria (BFC's)

Site ______________________________

Sample Date / /

Count (1st 100 observations)

Observed Dominance (%)



This is where we're going

Composition, Dominance and Growth

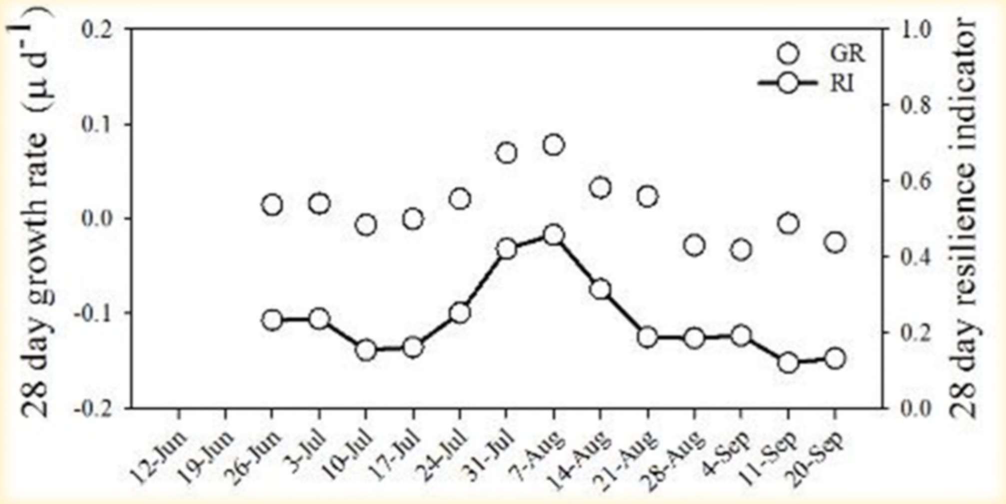
Resilience Indicators (RI) or Growth Rate (GR)
Sharp increase = Critical transitions

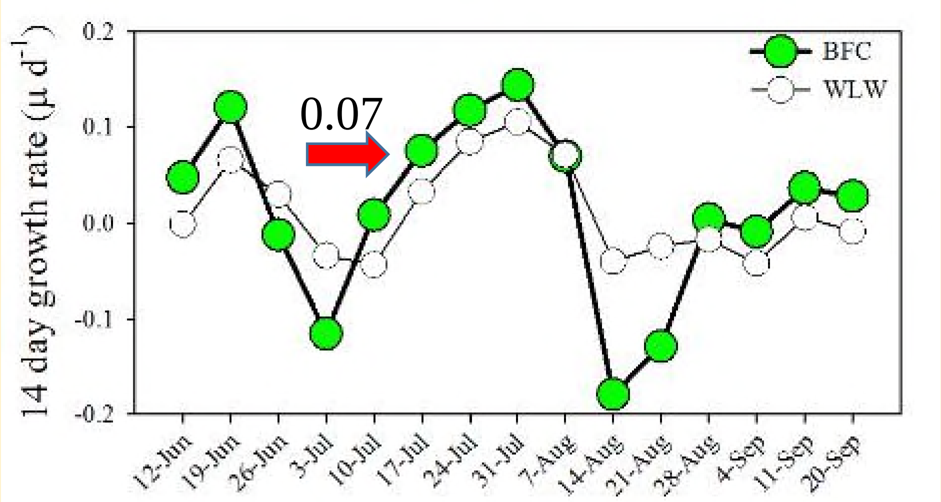
Growth rate

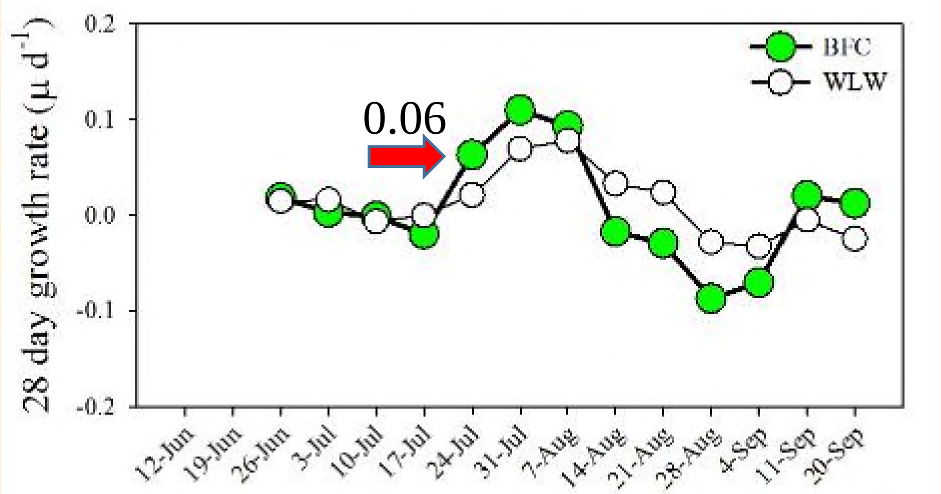
$\mu\ d^{-1} = \ln(PC_2) - \ln(PC_1)/t_2 - t_1$

Resilience Indicator

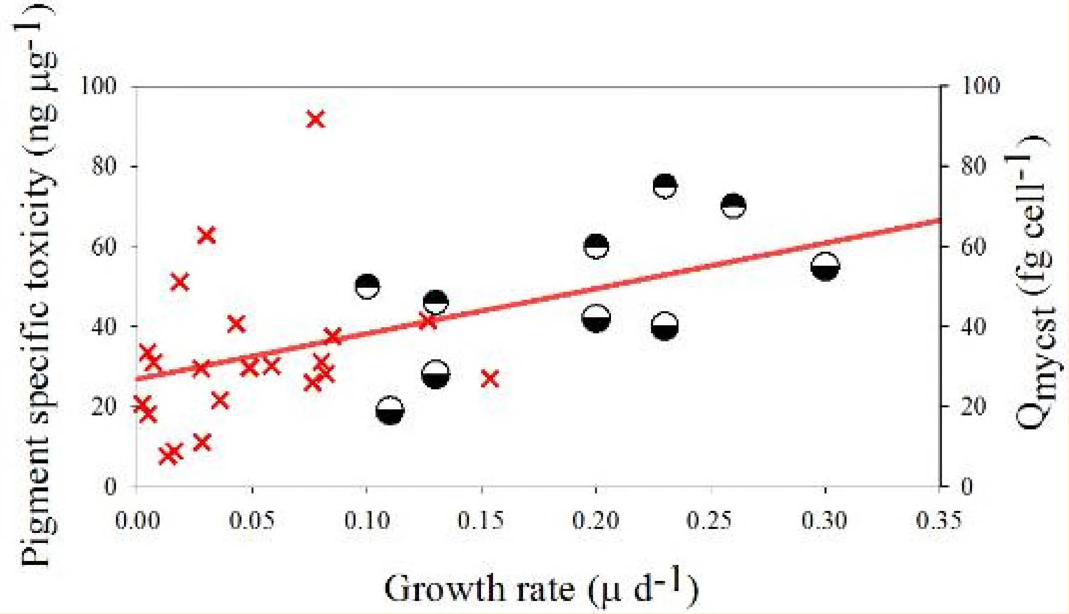
RI = Std. dev. 28 day PC







<u>What about toxicity ?</u>



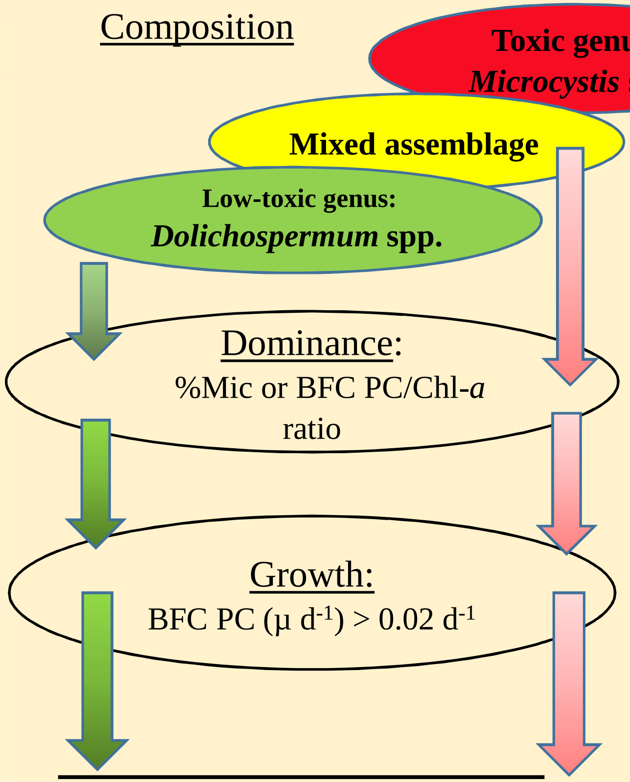


Table 2. Cyanobacterial biomass growth rates (GR) and doubling times (DT).

Growth rate (μ d^{-1})	Doubling time (days)
0.02	34
0.05	14
0.07	10
0.1	7
0.2	3

DT = 0.693/GR

Table 1. Regressions between cyanobacterial biomass and total microcystins in *Microcystis* spp. dominated systems, where Log Y = a + b * Log X where Y = Log MC (ng/L) and X = Log PC (µg/L)

Microcystis spp. dominated lakes

	a	b	Adj. r^2	n	p
Silver Lake	1.341	1.148	0.942	39	<0.001
Gooseberry Pond	1.899	0.923	0.791	16	<0.001

Cyanobacterial populations

Regression coefficients between cyanobacterial population size structure, biomass and total microcystins where Log Z = a + b*Log X + c *Log Y where Z = Log MC (ng/L), X = Log % Mic and Y = Log PC (µg/L)

a	b	c	Adj. r^2	n	p
-0.123	0.939	0.787	0.780	196	<0.001

Table 3 Cyanobacterial population size structure, growth rates and toxin production measured using cyanobacterial biomass as phycocyanin. Values as mean of observed positive growth rates and toxin production.

		Sample Type			
		WLW		**BFC**	
Community Composition	Growth category*	Growth rate (μ d^{-1})	MC/PC (ng μg^{-1})	Growth rate (μ d^{-1})	MC/PC (ng μg^{-1})
***Microcystis* spp.**	Low	0.01	24.0	0.02	47.72
	Med	0.05	37.7	0.04	53.90
	High	0.10	34.6	0.14	69.64
Mixed assemblage	Low	0.01	18.2	0.01	15.24
	Med	0.03	9.9	0.05	15.87
	High	0.10	10.4	0.18	14.81
Dolichospermum spp.	Low	0.01	0.31	0.01	0.37
	Med	0.05	0.75	0.04	0.42
	High	0.12	0.44	0.13	0.17

Low = < 0.02 d^{-1}, Medium = 0.02-0.07 d^{-1}, High = > 0.07 d^{-1}*

* Orr & Jones et al (1998), Kurmayer et al (2003), Chan et al (2004), Briand et al (2012), Chang et al (2012).

Project line-up for Summer 2019

Local decisions for cyanobacteria:
Measures of success

Exposure pathways

Impacts to endangered species

Thank you!